



# Current (and future) Automation Research



## Single Pilot Operations



## UAS Integration into the NAS





# Projects



## On-going projects:

- Single Pilot Operations
- Levels of Automation (UAS)
- Transparency

## Planned Projects:

- AutoMax
- Unmanned Traffic Management (UTM) System
- Trusted Systems



# Single Pilot Operations Research

## Motivation

- Cost Savings!
- *Occupies a space between dual pilot and unmanned aircraft systems (UAS)*
  - *UAS technology supports SPO*
  - *Retaining a human pilot more acceptable than UAS*

## Requirements

- Applies to Part 121 Transport Operations
- At least as safe as two-pilot operations with conventional dispatch
- Negligible additional burden on air traffic service provider
- Technologically and operationally feasible
- Economically beneficial

## Single Pilot Operations Simulation Study– August 2013

- Initial prototype ground station
  - Aircraft controls
  - Collaboration tools
- High fidelity motion based flight simulator with collaboration tools
- Very high workload diversions with equipment malfunctions



**Single Pilot Groundstation**



**Flight Deck with Collaboration Tools**



# HSI Subproject

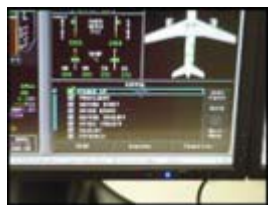


Efficiently manage contingency operations w/o disruption of the NAS

Seamlessly interact with SSI



Coordinate with ATC - respond w/o increase to ATC workload



Ensure operator knowledge of complex airspace and rules



**Leave Behind GCS**

Research test-bed and database to provide data and proof of concept for GCS operations in the NAS



Human factors guidelines for GCS operation in the NAS



Standard aeronautical database for compatibility



Traffic information for situation awareness and separation (NextGen)



# Full Mission Simulation



## ❖ Purpose:

- To examine the effects of different levels of automation control on UAS pilot ability to respond to ATC commands and traffic advisories/warnings
- What happens when a pilot that is operating “on-the-loop” (i.e. waypoint to waypoint mode) needs to quickly get “in-the-loop” to respond to ATC commands or traffic advisories?

## ❖ Experimental Design

- Independent Variables:
  1. Levels of Automation Control (3)
    - i. Waypoint to Waypoint (baseline)
    - ii. Waypoint + Knobs
    - iii. Waypoint + Stick and Throttle
  2. Event Type
    - i. ATC Clearance
    - ii. Well Clear Violation
    - iii. Resolution Advisory



# results







# Current research in automation transparency

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- Current work's goal is to investigate how automation transparency mediates appropriate trust in automation
  - Using task analysis, create a tool to identify automation transparency issues in automation
  - Examine the relationship between automation transparency and appropriate trust
- Project is using a new recommender system, the Emergency Landing Planner (ELP) as its technology
  - The system recommends the best potential diversion routes and runways for an emergency landing of a large commercial aircraft



# Current research in automation transparency

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- Project is devised into two studies that alter the amount, quality, and type of information as well as the GUI of the ELP.
- Project will also deliver a proposed task analysis tool to identify transparency issues within automation.
- Future proposed studies could:
  - Refine and test task analysis tool to identify transparency issues in other automated platforms
  - Examine the relationship between transparency and cultural influencers
  - Examine how automation transparency affects trust with multiple UAV's with multiple goals.





# **Enabling Civilian Low-Altitude Airspace and Unmanned Aerial System (UAS) Operations**

**By**

**Unmanned Aerial System Traffic Management (UTM)**

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**March 17, 2014**

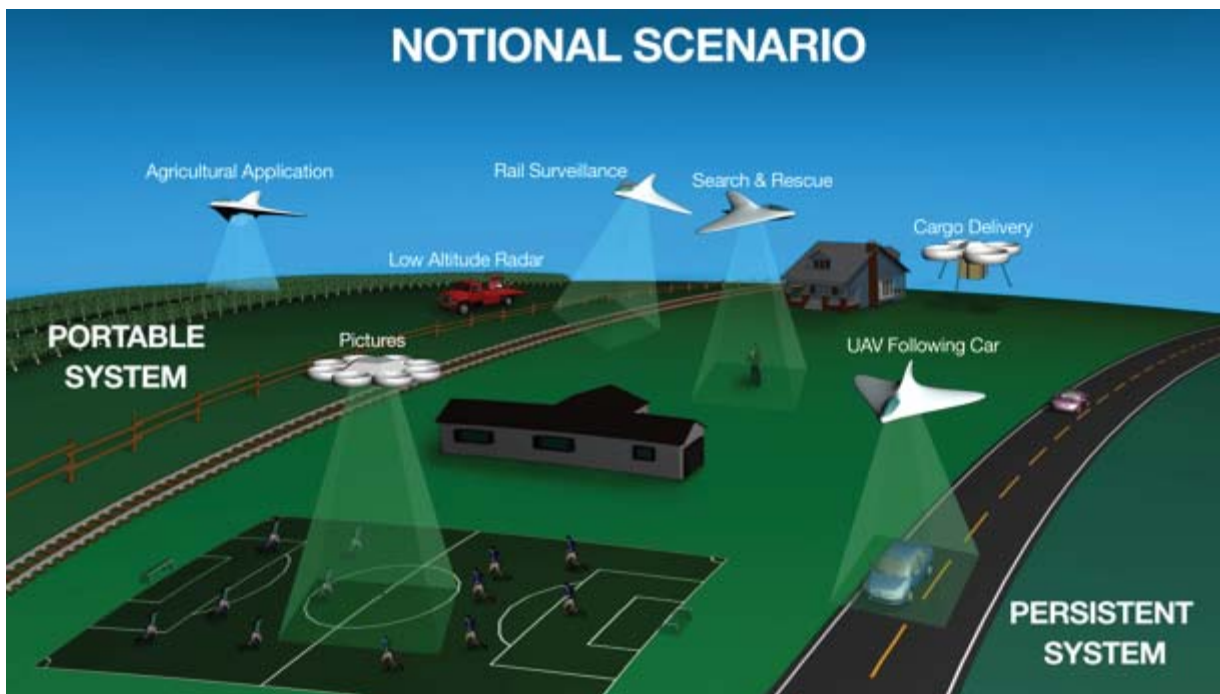


# Unmanned Aerial Vehicle (UAS) Traffic Management Enabling Low-Altitude Airspace and UAS Operations



## MOTIVATION

- Many UAS will operate at lower altitude (Class G, below 2000 Feet)
- There is urgent need for a system for civilian low-altitude airspace and UAS operations
- Stakeholders want to work with NASA to enable safe operations



## CONCEPT OVERVIEW

- UTM System will provide following services
  - Airspace design and geo-fencing
  - Weather integration
  - Congestion management
  - Separation management
  - Contingency management

## NEAR-TERM GOAL

Safely enable low-altitude operations within 5 years

## LONG-TERM GOAL

Accommodate increased demand 10-15 years



# UTM Concept Development - Status



## PROGRESS

- Developed UTM vision document
- Defined initial UTM design characteristics
- Conducted an all-stakeholder workshop to gather feedback
  - 145 non-NASA stakeholder representatives



## UTM Workshop: KEY FINDINGS

- Overwhelmingly positive response
- Stakeholders support NASA's leadership and vision
- Many partners are ready to engage
- There is urgency to put a system in place

## PARTNERSHIPS

- UAS manufacturers
- Online retailers
- Communication/navigation/surveillance providers
- System integrators
- Emerging UAS operators
- Cargo operators
- FAA, NOAA, DoD
- UAS test sites



## Next Steps



- Obtain authorization to proceed with further development of UTM
- Refine UTM design, architecture, and use cases
- Explore partnership arrangements to engage traditional and non-traditional partners
- Define a spiral development process to do rapid prototyping and early fielding with regular updates

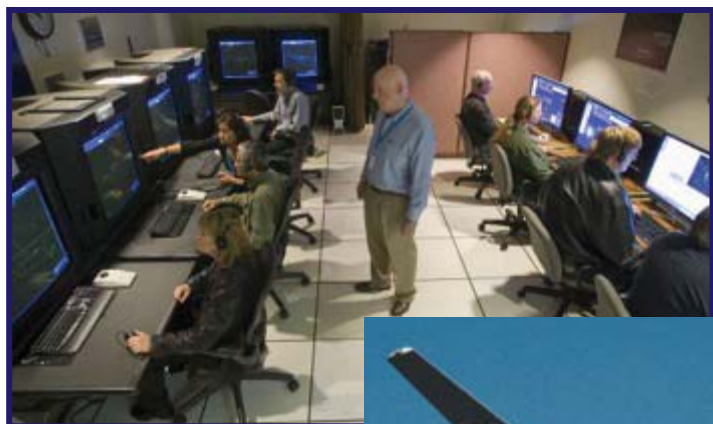
**NEAR-TERM GOAL:** Enable low-altitude operations within 5 years

**LONG-TERM GOAL:** Accommodate increased demand 10-15 years





# Questions ?



NASA's UAS cockpit situation display with TCAS advisories

